S
333.91
W3ecp
1970
Vol. III

TAP

ECONOMIC
CONSULTANTS

OFFICES
25 E. MENDENHALL
PHONE: 406 587-4461

MAILING ADDRESS
TAP INC.
P.O. BOX 471

BOZEMAN, MONTANA 59715

Digitized by the Internet Archive
in 2013

http://archive.org/details/preliminaryfeasi64tapi

STATE DOCUMENTS COLLECTION

JAN 3 1 1978

MONTANA STATE LIBRARY
930 E Lyndale Ave.
Helena, Montana 59601

Preliminary Feasibility Study for East Central Water Conservancy District

CHAPTER IV

Coal Resources & Development Potential

Submitted To;

State of Montana
State Water Resources Board
Helena, Montana 59601

Submitted By:

T.A.P., Incorporated
P. O. Box 471
Bozeman, Montana 59715

November 11, 1970

PLEASE RETURN

CHAPTER IV

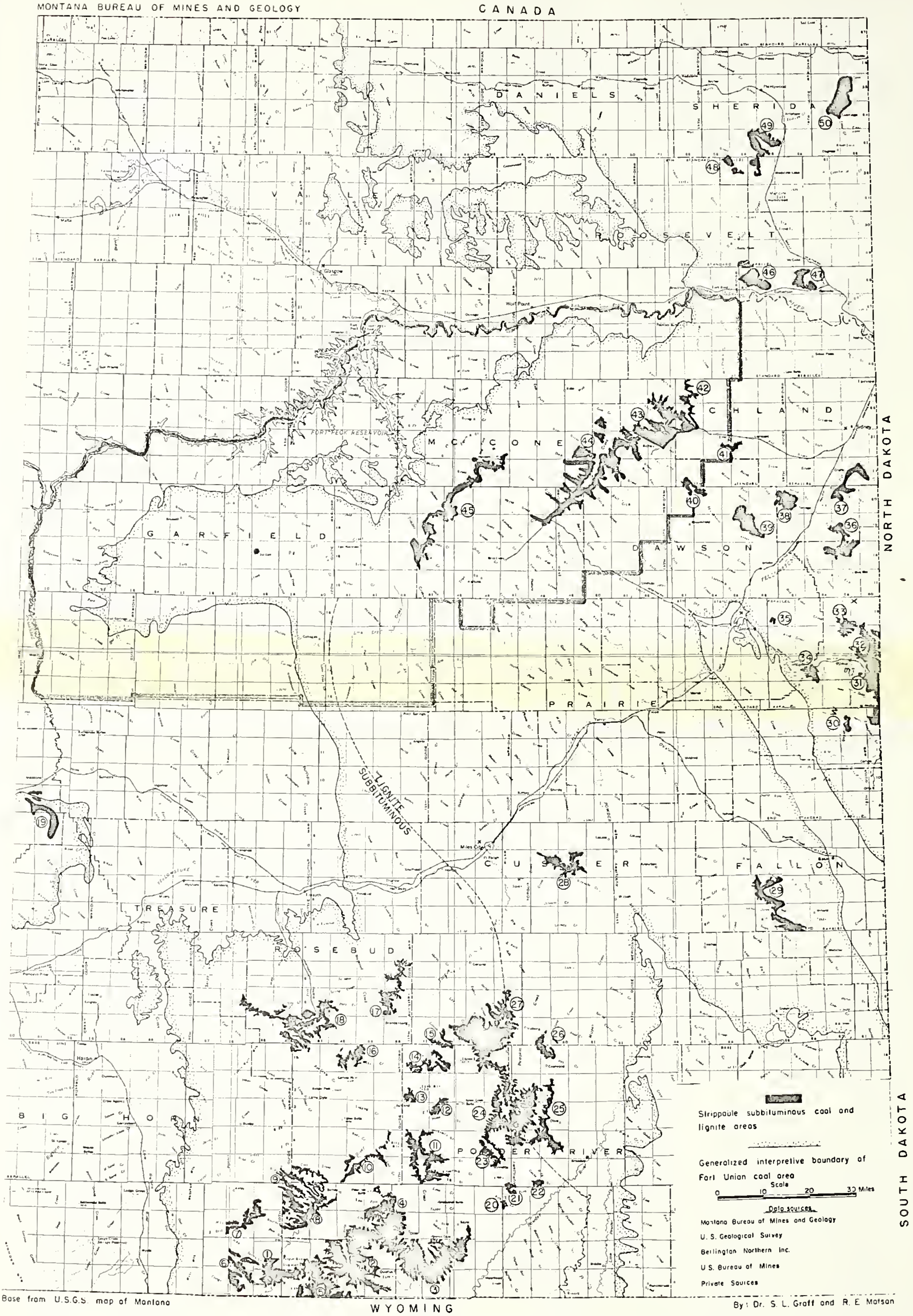
COAL RESOURCES AND DEVELOPMENT POTENTIAL

A. COAL AVAILABILITY

Introduction

Much of eastern Montana, including parts of McCone, Dawson, Richland and Garfield Counties is underlain by the Fort Union Formation, which in Montana contains coal beds in three members: the Tullock, Lebo and Tongue River Members. The total Fort Union Formation area, extending into western North Dakota, northwestern South Dakota, northeastern Wyoming and southeastern Saskatchewan is termed the Fort Union coal region. This region contains over a trillion tons of reserves of lignite and subbituminous coal within 3,000 feet of the surface (Averitt 1968), the largest coal region in the world. Figure IV:1 shows an outline of the Fort Union Coal Area and the Proposed East Central Water Conservancy District.

In terms of future development, however, only the lower-cost subbituminous coal and lignite mineable by surface methods in the Fort Union region will likely be utilized. (Under the classification system of the American Society for Testing Materials, coal with a calorific value from 6,300 to 8,300 Btu per pound on a moist-mineral-matter-free basis is ranked lignite. Coal with calorific value from 8,300 to 9,500 BTU is ranked as subbituminous C, and coal from 9,500 to 10,500 is classified as subbituminous B.) Total strippable reserves of lignite and subbituminous coal in Montana, Wyoming and North Dakota have


MONTANA BUREAU OF MINES AND GEOLOGY

Stripppable subbituminous coal and lignite areas

Generalized interpretive boundary of Fort Union coal area

Scale

0 10 20 30 Miles

Data sources

Montana Bureau of Mines and Geology

U. S. Geological Survey

Burlington Northern Inc.

U.S. Bureau of Mines

Private Sources

Base from U.S.G.S. map of Montana

By: Dr. S. L. Groff and R. E. Matson

Figure IV:1 - Fort Union Coal Area & the Proposed East Central Montana Water Conservancy District.

been estimated at 78 billion tons. Montana's strippable reserves of 18 billion tons consist of both subbituminous coal and lignite, of which the subbituminous reserves make up the larger portion of the total. In North Dakota, with estimated strippable reserves at 50 billion tons, all of the reserves are lignite. In Wyoming most of the 10 billion tons of strippable reserves are subbituminous (Averitt, 1968). Figure IV-1 referred to above, shows the occurrence of strippable coal in the Fort Union region of eastern Montana in addition to the relative boundary of lignite and subbituminous coal areas.

Coal Availability in Proposed Water Conservancy District

The strippable coal available in the proposed Water Conservancy District is lignite, and the strippable areas are shown on Figure IV- 1. The total estimated strippable lignite reserves of the district is estimated at 2,307 million tons. The strippable areas include the Weldon-Timber Creek deposit (Matson, 1970), the Redwater Creek deposit (Matson, 1970), the Carroll deposit (Ayler, Smith, and Deutman, 1969), the Lane deposit (Ayler, Smith and Deutman, 1969), and small areas in Garfield County (Mouat, 1970). Available analytical data of the various coal deposits are shown on Tables IV-A, IV-B and IV-C.

Weldon-Timber Creek Field

The Weldon-Timber Creek field extends from approximately

Source: 1. Preliminary Report, Strippable Coal Resources
McCone County by Robert E. Matson
2. Strippable Coal Resources of Montana by Ayler,
Smith, and Deutman

Drill hole no. and location	U.S. Bur. Mines lab sample no.	1/	Mois-ture	Volatile matter	Fixed carbon	Ash	S	H	C	N	O	Heat value (Btu/lb.)
S McC-9	J-10014	A	29.9	27.5	36.9	5.7	0.2	6.1	46.3	0.7	41.2	7,520
NW$\frac{1}{4}$ NW$\frac{1}{4}$ sec. 36,		B		39.3	52.6	8.1	0.3	4.0	66.1	1.1	20.4	10,730
T. 21 N., R. 45 E.		C		42.7	57.3		0.3	4.3	72.0	1.2	22.2	11,680
S McC-11	J-10015	A	30.5	27.7	35.9	5.9	0.6	6.2	46.6	0.8	39.9	7,660
SW$\frac{1}{4}$ NW$\frac{1}{4}$ SW$\frac{1}{4}$ sec. 16,		B		39.8	51.7	8.5	0.9	4.1	67.1	1.1	18.3	11,020
T. 18 N., R. 44 E.		C		43.5	56.5		1.0	4.4	73.3	1.2	20.1	12,040
S McC-12	J-10016	A	31.7	27.2	35.0	6.1	0.4	6.3	45.2	0.7	41.3	7,400
SW$\frac{1}{4}$ SW$\frac{1}{4}$ SW$\frac{1}{4}$ sec. 16,		B		39.9	51.2	8.9	0.6	4.1	66.2	1.1	19.1	10,840
T. 19 N., R. 44 E.		C		43.8	56.2		0.6	4.5	72.7	1.2	21.0	11,890
S McC-16	J-10017	A	31.6	24.8	32.9	10.7	0.2	5.9	42.0	0.7	40.5	6,750
SW$\frac{1}{4}$ SW$\frac{1}{4}$ sec. 2,		B		36.2	48.1	15.7	0.3	3.5	61.4	1.0	18.1	9,860
T. 19 N., R. 48 E.		C		43.0	57.0		0.3	4.1	72.9	1.2	21.5	11,690
Sec. 1, T. 20 N.,	I-57171	A	36.4	25.0	31.8	6.8	0.3	6.4	41.1	0.8	44.6	6,610
R. 49 E. Stephensen		B		39.3	50.0	10.7	0.4	3.7	64.7	1.3	19.2	10,390
Mine		C		44.1	55.9		0.5	4.1	72.4	1.4	21.6	11,630
Sec. 8, T. 22 N.,		A	33.0	25.5	36.0	5.5	0.3					7,400
R. 51 E., Carroll		B		38.1	53.7	8.2	0.5					11,050
Mine		C		41.5	58.5		1.6					12,030
Sec. 26, T. 23 N.,		A	36.5	26.9	30.0	6.6	0.9					7,150
R. 53 E., Lane		B		42.4	47.2	10.4	1.4					11,250
Mine		C		47.4	52.6		1.5					12,560

1/ Form of Analyses: A - as received; B - moisture free; C - moisture and ash free.

Table IV:B Ash Fusibility, S Coal Bed

Source: Preliminary Report Strippable Coal Resources,
McCone County, Montana by Robert E. Matson

			Ash fusibility, °F		
Bed	Drill hole no.	U.S. Bur. Mines lab no.	Initial deformation temperature	Softening temperature	Fluid temperature
S	S McC-9	J-10014	2480	2520	2560
S	S McC-11	J-10015	2170	2220	2270
S	S McC-12	J-10016	2080	2180	2260
S	S McC-16	J-10017	2060	2100	2140

Table IV.C Analyses of Ash, 1/ S Coal Bed

Source: Preliminary Report Strippable Coal Resources,
McCone County, Montana by Robert E. Matson

Drill hole no.	S McC-9	S McC-11	S McC-12	S McC-16
U. S. Bur. Mines lab no.	J-10014	J-10015	J-10016	J-10017
SiO_2	23.5	6.9	21.8	51.9
Al_2O_3	11.5	4.6	11.1	12.6
Fe_2O_3	4.0	14.4	7.1	2.3
FeO	.20	.20	.20	.20
MgO	11.4	6.9	6.8	4.8
CaO	36.5	27.1	23.6	13.3
Na_2O	1.7	4.8	7.0	5.2
K_2O	.47	.67	1.2	1.9
H_2O-	.12	.04	.02	.03
H_2O+	.58	.63	.60	.83
TiO_2	.42	.18	.46	.52
P_2O_5	.11	.08	.42	.26
MnO	.09	.12	.17	.09
CO_2	.38	$<.05$	$<.05$	.19
S as SO_3		33.2	18.0	6.2
Total	100	100	99	100

1/ Analyses by U. S. Geol. Survey, Washington, D. C., using methods described in U. S. Geol. Survey Bull. 1144-A, supplemented by atomic absorption.

1 1/2 miles south of Weldon in section 12, T. 21 N., R. 45 E., southwest to T. 18 N., R. 44 E., along the valley of Timber Creek (Figure IV-2, No. 45). The topography of this area ranges from rolling to rough and includes areas of deeply incised drainages and steep-sided buttes. The S coal bed underlying the area has burned, forming prominent, brightly colored clinker at the western edge of the deposit. In general, the strippable coal area is confined by the burned area on the west and by a 150-foot overburden limit line to the east. The width of the strippable coal area ranges from 1/2 mile to 2 miles. Several prominent east-west drainages have created broader local strippable areas, such as in T. 20 N., R. 45 E.

The S bed is 12 feet thick in the northernmost part of the field. It thickens to 20 feet in sec. 16, T. 20 N., R. 45 E., and again thins to 8 feet in sec. 16, T. 18 N., R. 44 E. The R bed, 50 feet above the S bed in T. 18 and 19 N., R. 44 E., has a thickness of 6 to 8 feet and could be strip mined in some places, but its reserves are not included in this report. Data on the quality of the lignite is shown on Tables IV-A, IV-B and IV-C under drill hole numbers S McC-9, S McC-11 and S McC-12.

The indicated strippable reserves in the Weldon-Timber Creek area total 724 million, of which 345 million tons could be mined in the approximate center of the field in T. 20 N., R. 45 E., the southeast corner of T. 20 N., R. 44 E., and the northwest corner of T. 19 N., R. 45 E.

Redwater Deposit

The strippable part of the Redwater deposit is confined to the low valley sides along Redwater Creek and near the mouth of Horse Creek. Rapidly increasing overburden makes strip mining impractical more than 3 miles northwest of Circle. Along Redwater Creek, northeast of Circle, the S bed is below creek level almost to the Stephensen mine in Sec. 1, T. 20 N., R. 49 E., where it is a few feet above creek level. (Figure IV-2, No. 44) North of the Stephensen mine, the S bed crops out along the sides of the valleys of Redwater Creek and its tributaries.

The S bed decreases in thickness from south to north. Its maximum thickness is 21 feet in sec. 2, T. 19 N., R. 48 E.; the thickness decreases to 7 feet 11 inches in sec. 6, T. 21 N., R. 49 E., along Duck Creek. Other factors, however, may favor development of the northern part of field where there is no drainage problem nor any need to divert streams. There, too, the value of the surface is lower. Analytical data on the S coal bed is shown on Table IV-A under drill hole S McC-16 and the Stephensen mine. Ash fusibility and analysis for drill hole S McC-16 are shown on Tables IV-B and IV-C respectively.

The strippable reserves of the Redwater deposit total 642 million tons under a maximum overburden thickness of 150 feet. Additional field work, supplemented by drilling, should increase the reserves appreciably.

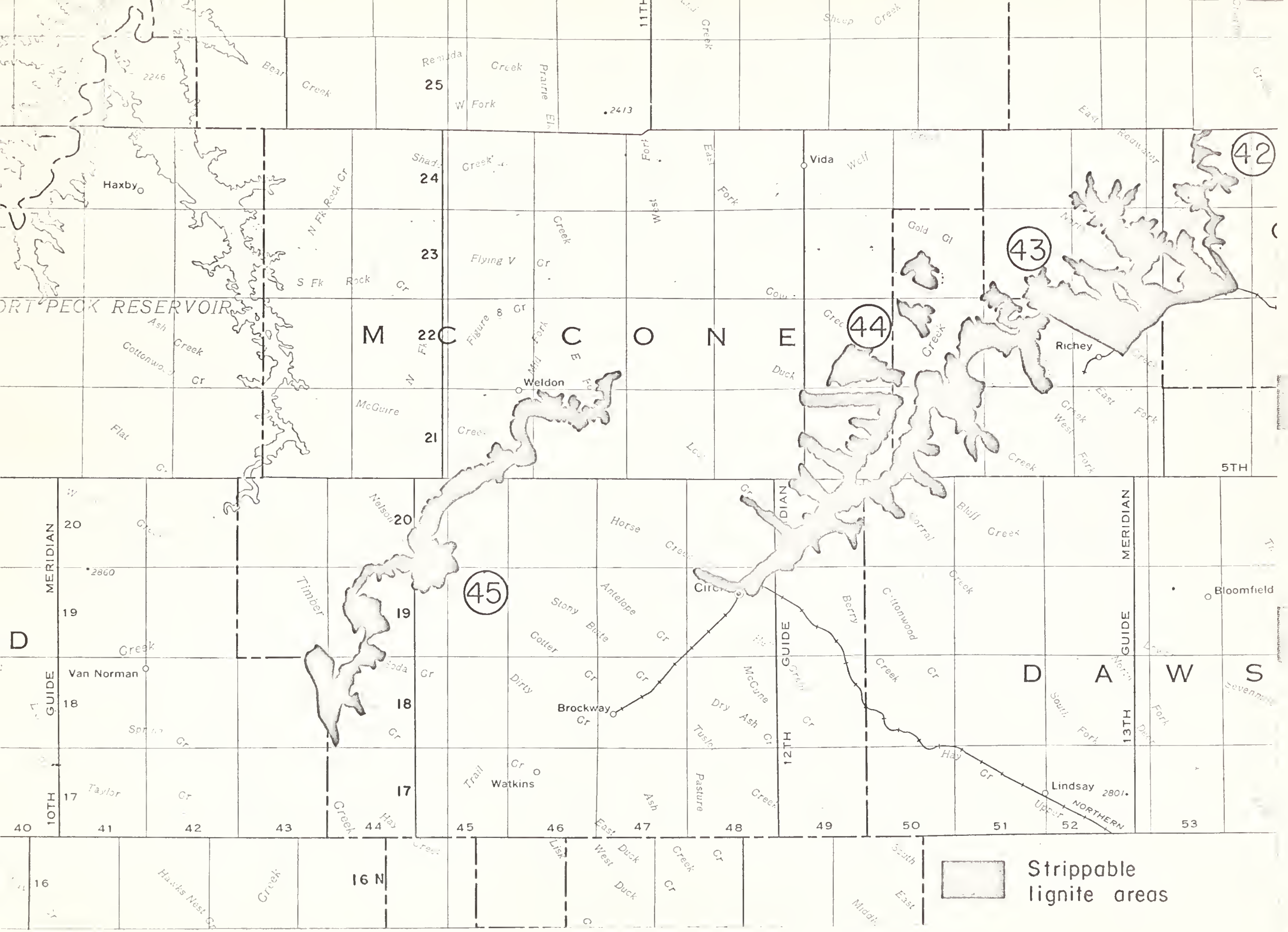


Figure IV:2 - Strippable lignite in proposed Water Conservancy District McCone, Garfield, Richland, and Dawson Counties, Montana

Carroll Deposit

The Carroll deposit is a northeastward continuation of the Redwater deposit described above and is located in T. 20, 21, 22 and 23 N., R. 50 and 51 E. in Dawson and Richland Counties. (Figure IV-2, No. 43) The Carroll bed is the same coal bed as the S coal bed described in the Redwater deposit. The average thickness of the Carroll bed is 6.5 feet with a total reserve estimated at 345.4 million tons. An analysis from the Carroll mine located in sec. 8 T. 22 N., R. 51 E. is shown on Figure IV-2 (Ayler, Smith and Deutman, 1969, p. 50 and 51).

Lane Deposit

The Lane coal deposit straddles the Richland-Dawson County line in T.22, 23 and 24 N., R. 51, 52 and 53 E.(Figure IV-2, No. 42). The measured thickness of the Lane coal bed varies from 2.5 to 9.5 feet with an average thickness of 7 feet. The total inferred reserve is 561.5 million tons. An analysis of the Lane coal bed taken from the Lane mine, located in sec. 26, T. 23 N., R. 53 E., is shown on Table IV-A (Ayler, Smith and Deutman, 1969, p. 51).

Garfield County

Very little information on the occurrence of coal in Garfield County is available at this time. The U. S. Geological Survey Mineral Classification Branch has been conducting a survey in the county for a number of years; however,

no information has been published. According to George Mouat (U.S.G.S. personal communication), there are two small potential strippable areas west of Jordan with reserves of about 5 million tons each underlain by coal beds with measured thicknesses of 5 feet. In addition, 6 to 10 miles northeast of Jordan two strippable coal deposits occur with each having potential reserves of 20 to 25 million tons underlain by coal beds with measured thicknesses of 5 and 6 feet. Other areas with potential occur approximately 18 miles northeast of Jordan and in the extreme eastern part of Garfield County adjoining the southern part of the Weldon-Timber Creek deposit in T. 17 N., R. 43 E. and T. 16 N., R. 44 E. No analytical data on Garfield County coal is currently available.

Factors Restricting Development to Date

The coal resources occurring within the proposed Conservancy District, as well as other areas in eastern Montana, have not been developed due to long distances from large market areas. In addition, availability of natural gas in the State rapidly curtailed domestic coal markets following World War II. Population declines, coupled with lack of industrial markets, further curtailed power needs in eastern Montana while western Montana's power needs were supplied by hydro sources. It has only been in the last few years that the Fort Union coal region has been looked upon as a potential supplier of power and fuels.

B. DEVELOPMENT POTENTIAL

Introduction

The development potential of eastern Montana and the area included in the proposed Water Conservancy District are enormous when viewed over the next 30-year period. The development which will occur will include both synthetic fuels and chemicals and a related power generation industry. The power generation industry will utilize coal and by-product char from synthetic fuel plants and will be tied to both Mid-Western and West Coast markets by extra-high-voltage (E.H.V.) transmission lines or super conductors.

Utilization of coal in the Fort Union coal region is a logical way to meet much of the nation's future power and fuel requirement; however, a great deal of research, pilot plant operation, planning and coordination remains to be done. Research underway required to optimize development of the Fort Union coal region includes the development of economic processes for producing synthetic fuels, development of the MHD generator, development of transportation networks for moving large blocks of power through extra-high-voltage (E.H.V.) lines or super conductors and development of transportation systems for moving synthetic fuels to market.

National growth in electric power consumption requiring doubling of capacity every 10 years, due to restrained population growth to doubling every 12 years, presents a tremendous market for eastern Montana coal. To the energy planners of

of private industry, public utilities, power cooperatives, and Federal agencies it poses a tremendous challenge -- that of supplying distant markets from an area until now considered to be remote. In the long run, however, the vast coal deposits may prove to be stratigically located halfway between the large markets of the Mid-West and West Coast.

The United States coal reserves are much greater than the reserves of petroleum and natural gas. In fact, the recoverable coal determined by mapping and exploration is over 30 times the energy content of petroleum and natural gas combined, making coal a very attractive material for supplementing fluid fuels (Cameron, 1970). The largest uncommitted coal reserves are in the Fort Union coal region in Montana, Wyoming and North Dakota.

Synthetic Fuels

A large research effort is underway by private industry and Federal agencies in finding economic processes for producing synthetic fuels from coal. The reason for this effort is the fact that the proved reserves of petroleum and natural gas are only sufficient to supply the needs of the United States for less than 15 years at the current rate of consumption (Cameron, 1970).

The natural gas situation in areas of the United States is very critical, and cost estimates of producing synthetic pipeline gas from coal is now competitive with natural gas in

some populated areas of the Mid-West and East. The Institute of Gas Technology predicts that the first commercial synthetic gas plant will be built in the mid 1970's, following successful operation of its high pressure gasification pilot plant on which construction was completed in June, 1970. I.G.T. has been investigating high pressure gasification of coal since the mid 1950's and has received funding from the Office of Coal Research in construction of the pilot plant. Design of the first demonstration plant is under contract, and a study to identify gasification plant sites throughout the nation has been completed. It is anticipated the first demonstration plant could be completed in 1974 (Office of Coal Research, 1970).

Another system for gasification of coal of importance to Montana and the proposed Conservancy District is the CO_2 Acceptor Process, a project developed by Consolidation Coal Company and supported by the Office of Coal Research. A pilot plant is now under construction near Rapid City and programmed to become operational by April, 1971. Montana subbituminous coal and lignite seem to be well suited to this process, which will develop by-product char. The char could be utilized as a fuel in power generation. The basic feature of the CO_2 Acceptor Process is the gasification of coals in the presence of calcined limestone and dolomite which react with CO_2, providing heat for the process and purifying the gas in situ. The product will be a methane rich synthetic gas (OCR, 1970).

Another OCR experimental study on coal gasification is being carried out by Bituminous Coal Research. At West Virginia University OCR is sponsoring a project on computer optimization of coal gasification processes to integrate, if possible, parts of various gasification systems into more feasible systems.

In coal conversion to liquids, OCR is sponsoring Project Gasoline and Project COED, both of interest to Montana's future development. Project Gasoline, under continuous sponsorship by OCR since 1963 and costs totaling $22,066,650, has been operating for 3 years, during which time it has been plagued by mechanical problems, preventing accumulation of data needed to design a commercial plant (OCR, 1970).

Project COED, developed and under contract by the F.M.C. Corporation, with $9,734,000 OCR participation, is a process for the multi-stage fluidized bed pyrolysis of coal, yielding synthetic crude oil, hydrogen or pipeline gas, and low-sulfur char. A pilot plant utilizing 36 tons of coal per day was completed in 1970 (OCR, 1970). The COED process produces an oil which can be upgraded to the equivalent of natural crude oil but results in a large quantity of by-product char. A large plant, which a capacity of 30,000 barrels of synthetic crude per year, would produce char to supply the annual requirement of 1,500 megawat power plant. Montana subbituminous coal and lignite are suitable for the process, but yields are generally smaller than from higher rank coals. Commercializa-

tion of the process could occur by 1977 (Cameron, 1970, p. 31 and 32).

Bench-scale research on coal conversion is being conducted at Montana State University under direction of Dr. Lloyd Berg, Department of Chemical Engineering. Research has been centered upon conversion of subbituminous coal and lignite with and without a catalyst. Private companies which already have production or coal leases in the Fort Union Region of Montana, Wyoming, and North Dakota and are involved in developing technology for converting coal to synthetic fuels are Humble Oil Company, Continental Oil Company, Gulf Oil Company, and Peabody Coal Company.

Humble Oil Company, through its research affiliate, Esso Research and Engineering Company, has operated a pilot coal conversion plant at Baytown, Texas, for the last 2 1/2 years and has been successful in liquefying coal on a continuous basis.

Continental Oil Company, through its subsidiary the Consolidation Coal Company, has been involved in coal conversion for many years. Two of the oonversion schemes, one for gasification and one for liquefaction, are currently sponsored by the Office of Coal Research. These are Project Gasoline at Cresop, West Virginia, and the CO_2 Acceptor Process for which a pilot plant is under construction near Rapid City, South Dakota.

Gulf Oil Company acquired the Pittsburg and Midway Coal

Company, which was investigating deashing coal through liquefaction.

Peabody Coal Company and Panhandle-Eastern Pipeline Company announced on May 5, 1970, that they would develop a system for gasifying coal.

Electric Power Production and Transmission

Spokesman for the energy industry states that future conversion plants, as those described above, will need to take advantage of the economics of scale. For example, a plant for producing a synthetic crude of 100,000 barrels per day will require from 20 to 25 million tons of coal each year (Herrington, 1969, p. 186). The Office of Coal Research visualizes future conversion plants as integrated with power production utilizing by-product char produced from the conversion process (Cockran, 1969, p. 171).

Establishment of large electric power generation centers in the Fort Union coal region interties between the West Coast and Mid-West are a very definite possibility. Walter J. Hickel, Secretary of the Interior, predicts that a grid of regional high-voltage transmission lines will tie the various sections of the country together by 1980 (Electric World, 4-20-70, p. 171).

Under existing technology, transmission of power from the Fort Union coal region to both the West Coast and Mid-West is feasible, according to the Federal Power Commission (1964) and the Department of Interior (1968) in "Transmission Study 190".

This later report shows that peak power demands between the Mid-West and West Coast are two hours apart, as are the seasonal peaks, allowing transfer of available power from one region to the other to meet demand.

Present coal-fired steam electric power systems operate on an efficiency rating of around 45 percent. In connection with integrated power and coal conversion plants, the Office of Coal Research has received additional funding from Congress to support research on magnetohydrodynamics (M.H.D.). It is believed that power production efficiencies in the 60 percent range can be achieved through M.H.D. For a continuous M.H.D. generator, considerable development work needs to be done. Avco Everett Research Laboratories have developed M.H.D. generators capable of short-time loads and have stated a desire to develop a pilot plant project for a continual M.H.D. generator in Montana, pending availability of OCR funding. The M.H.D. generator would produce direct current, which is necessary for cryogenic cable transmission.

Power can be transmitted by either aboveground (conventional) or by underground means. Because of the drawback of aboveground transmission lines, there has been considerable effort to develop underground lines that can compete with aboveground lines. Research has concentrated on cryogenic cables. The cryogenic cable consists of a thermally insulated pipeline with a probable diameter of 30 inches, filled with liquid circulating nitrogen, maintained at a temperature

between 14-20° K by spaced refrigeration stations. The current is carried in dual copper wires with cores of superconducting alloys, such as niobium-zirconium (Steinberg, Powell, Manowitz, 1969) and (Groff, 1970).

Current Markets for Coal

Ultimately, development of large power plants intertied with the markets of the Mid-West and West Coast will replace the large market developing and being supplied by unit train shipment of Montana's low-sulfur subbituminous coal. This coal is presently being shipped across the lignite fields of North Dakota from the Colstrip area to supply low-sulfur coal to markets as distant as Indiana to reduce sulfur dioxide emission of electric power plants. Another mine development at Decker is planned to supply some of these markets.

As we stated earlier, lignite is a lower rank coal than subbituminous with a lower heating value and a higher moisture content. Therefore, lignite cannot compete favorably in distant markets with subbituminous, and strip mining costs for lignite and subbituminous coal per ton are very close to the same. When calculated on the basis of cost per million BTU, lignite mining costs are higher. Mining costs for 15 strippable coal fields have been calculated, averaging $1.39 ton on the basis of a 10 million ton per year operation (Matson, Van Voast, and Cameron Engineers, 1970). Using these costs and an average lignite calorific value of 7,000 BTU per pound versus subbituminous at 9,000 BTU per pound, the mining costs of lignite

and subbituminous are 10 cents and 08 cents per million BTU, respectively.

Subbituminous coal has another advantage over lignite--in long-distance transportation. Using the calorific values of lignite and subbituminous above and the cost of moving coal by unit train at 4 mills per ton mile for a distance of 1,000 miles, lignite transportation costs per million BTU are 29 cents versus 22 cents for subbituminous. Delivered fuel prices are estimated at 39 cents per million BTU for lignite and 30 cents per million BTU for subbituminous.

Subbituminous coal has other advantages over lignite in long-distance transportation, including a lower moisture content, and the fact that it takes more lignite to produce the same heat content as subbituminous. Therefore, more fly ash is produced, and more sulfur dioxide emission occurs.

Since there are large areas of subbituminous coal mineable by strip mining methods, it is not likely that lignite will compete in supplying distant markets.

Current Leasing Activity

Applications for Federal coal leases on file in the U. S. Bureau of Land Management office in Billings are a good indicator of the areas of interest to major energy companies. Most of the current applications are in areas underlain by subbituminous coal, indicating that immediate interest is for acquisition of BTU or higher rank coal.

Likely Future Coal Based Installation

Future development of a steam power generation industry in the proposed Water Conservancy District will depend on how rapidly technological improvements are made in developing competitive synthetic fuels. For the purposes of this study, it is assumed that sufficient information will be available to permit completion of one conversion plant with an associated electric power production facility by 1980. It is further assumed that national political decisions will be favorable towards developing a synthetic fuel industry, and that transportation facilities, power interties for marketing power, and pipelines for synthetic fuels will be available for marketing products.

The advantage of constructing a conversion plant near Fort Peck Reservoir would be the availability of large quantities of water. It is assumed the plant would be a mine-mouth plant on the Weldon-Timber Creek deposit.

Total mapped strippable reserves (Matson, 1969) in the Weldon-Timber Creek deposit alone would be ample to supply a large conversion plant for a period of 35 years at an annual mining rate of 20 million tons per year.

Size of Coal Based Installations

The present electrical power shortages in many areas of the United States and the forecasts of rapidly increasing demand for electricity indicate a growing market for coal for elec-

trical power generation. Present technology and practices favor conventional coal-steam-electricity power plants for at least ten years. Another electrical power generating process is called magnetohydrodynamics (M.H.D.). A pilot plant utilizing this process may be constructed somewhere in Montana. The process involves the superheating of gas from coal and passing it through an intense magnetic field to produce direct current. It is claimed that the efficiency should be much greater than that of coal-steam plants, with less atmospheric pollution. Water requirements should be low. Another process called electrogasdynamics has been studied. It is said the cost of power plants of the EGD process would cost about 20 to 30 percent of equivalent capacity conventional plants and have a much higher efficiency.

Operation of a conventional 500 MW steam generation plant, as referred to in Chapter V, is possible under existing technology and would require 7,200 acre-feet of water per year. Such a plant, cnnstructed within the next ten years, would employ from 35 to 45 individuals--20-25 in the generation plant and 15-20 in the mining activity itself.

All spokesmen for planned conversion processes, both in industry and Federal agencies, state that future commercialization will require huge size to be economic. Neal Cochran of the Office of Coal Research visualizes (Cochran, 1969, p. 171) a M.H.D. facility requiring 50,000 tons of coal per day, producing 102,000 barrels per day of synthetic crude and 125

million cubic feet of synthetic pipeline quality gas each day. The accompanying electric power plant utilizing by-product char would produce 1,750 MW of which 1,250 MW would be available for export. Construction of plants of this size would create satellite industries for the manufacture of plastics, petro chemicals, and refinery products. Mining investment for the coal volume required would approach $50 million, and costs of the conversion facilities would approach $350 million (Herrington, 1969, p. 186). A possible facility layout is shown on Figure IV:3.

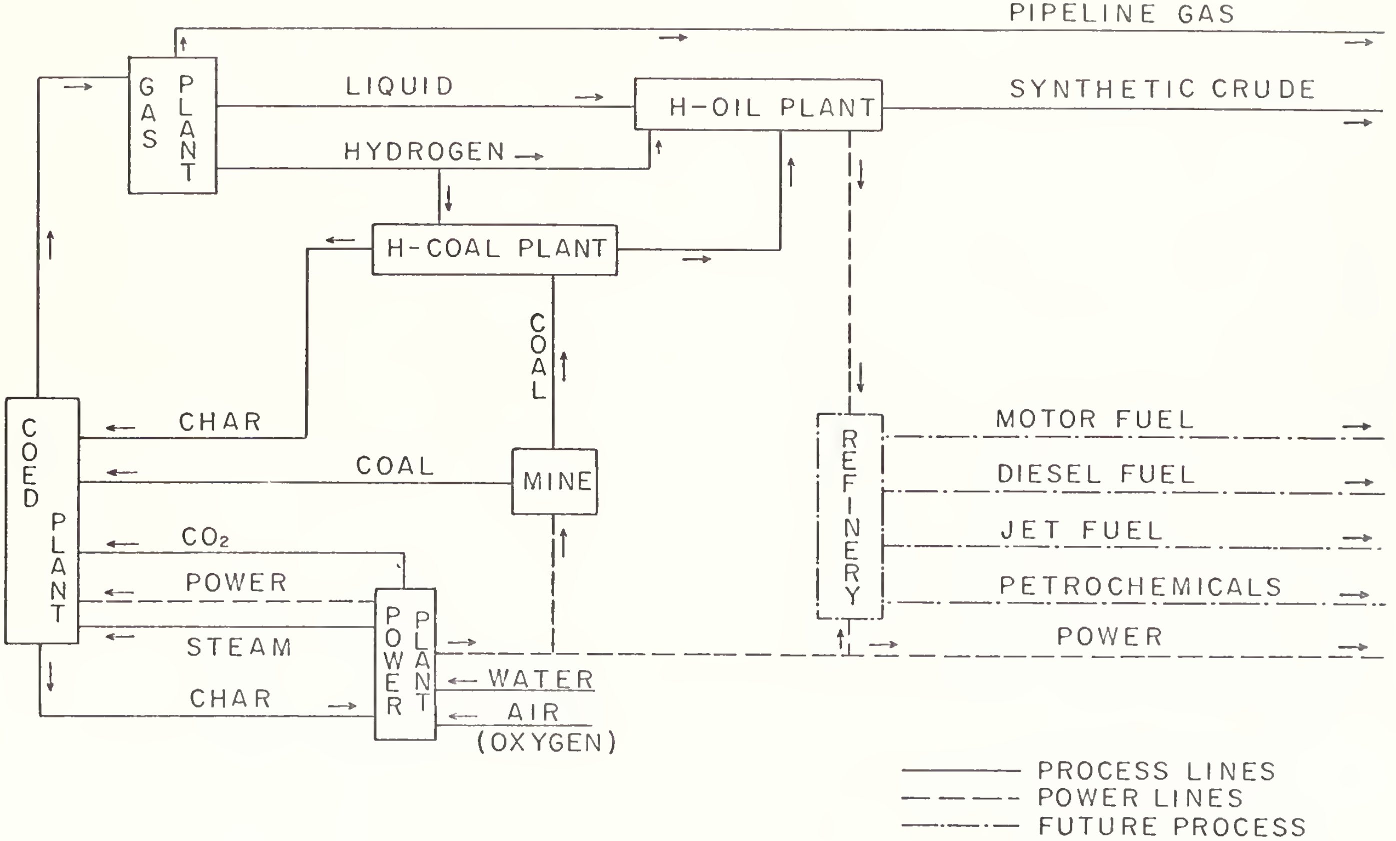
Water requirements for an optimum sized power generation-coal conversion plant complex are approximately 60,000 acre-feet per year, and of this 30,000 acre-feet may be discharged as warm (90°_ water for use in special irrigation.) With new generation power being available, however, it would be possible to pump additional cold water for agricultural purposes (Groff, 1970, personal communication).

A conversion-power plant as that envisioned would create jobs in mining, manufacturing, and refining. One such plant could create 15,000 new jobs (Cochran, 1970, p. 173) of which about 500 would be directly engaged in mining. The remainder would be professional engineers, administrators, and highly-trained technicians. Income anticipated would therefore be high with a large percentage of the personnel on annual salaries.

Environmental Disturbances and Reclamation

Environmental disturbances associated with a conversion-

PROJECT GAS OIL POWER



Source: Cochron OCR - October 1969

Figure IV:3

power plant complex would be very minimal, considering recycling and utilization of all of the constituents of lignite. Ash disposal or utilization could be one of the larger environmental problems, but on a mine-mouth complex it could be utilized in a land reclamation project. Proponents of M.H.D. say that M.H.D. would release no pollutants into the atmosphere. In fact, the sulfur and nitrogen oxide recovered in the process can be converted into fertilizers and sold. Higher efficiencies expected from M.H.D. will also alleviate thermal pollution problems. Mined-land reclamation research in Montana has progressed to the point where successful reclamation can be achieved with costs approximating 2 cents for each ton of coal mined.

REFERENCES

American Society for Testing Materials, 1964, Tentative specifications of classification of coals by rank: Am. Soc. Testing Materials Designation D 388-64, p. 73-78.

Averitt, Paul, 1968, Total estimated remaining coal resources of the United States: U. S. Geol. Survey Open-File Rept., 1 p.

____________, 1968, Stripping-coal resources of the United States: U. S. Geol. Survey Bulletin 1252-C, 20 p.

Cameron Engineers, 1970, Preliminary summary report of strippable low-sulfur coals of southeastern Montana; Part 2, Markets for Montana coal, MBMG Open-File Report, 37 p.

________________, 1969, Wyoming mineral industries, review and forecast, Book II, mineral fuels: a report to the Wyoming Natural Resource Board and State Water Planning Program, p. 231-360.

Cochran, N. P., 1969, Project gas, oil, power: Proceedings of the Montana Coal Symposium, Nov., 6 & 7, 1969, Eastern Montana College, Billings, Mont., p. 170-173.

Electric World, 1970, Hickel sees government-run national grid: April 20, p. 19.

Groff, S. L., 1970, Underground transmission of Rocky Mountain thermal power to the Pacific Northwest--an exciting probability: Paper presented at National Right-of-Way Association conference, Portland, Oregon, Nov. 4-6, 1970, 11 p.

Herrington, C. G., 1969: Prospects for coal liquefaction: Proceedings of the Montana Coal Symposium, Nov., 6 & 7, 1969, Eastern Montana College, Billings, Mont., p. 183-187

Matson, R. E., and Van Voast, 1970, Preliminary summary report of strippable low-sulfur coals of southeastern Montana: MBMG Open-File Report, 91 p.

Matson, R. E., 1968, Preliminary report strippable coal resources, McCone County, Montana: Mont. Bur. Mines and Geol. Bulletin 78, 13 p.

Mouat, G., 1970, Personal communication: U. S. Geological Survey, Billings, Mont.

OCR, 1970, Office of Coal Research annual report, 67 p.

Staff, 1968, Transmission study 190: Department of Interior steering committee report, 38 p.

Steinberg, M., Powell, J., and Manowitz, B., 1969, The western coal deposits: A national source of power: 4th annual International Society of Energy Conversion Engineering Conference Proceedings, p. 188-206.